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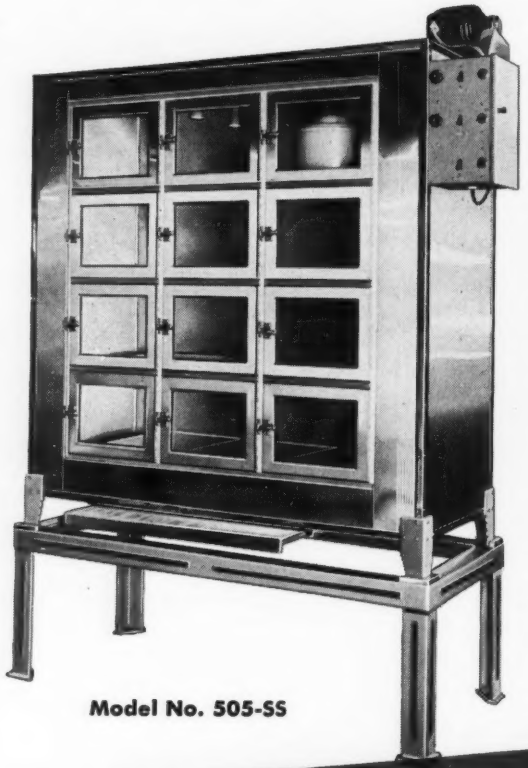

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LETTERS to the editor

CORRECTION: CANADIAN GRAIN LABORATORIES

DEAR SIR:

In the November issue of CEREAL SCIENCE TODAY there appears, under *Overseas Reports*, an item on Canada dealing with the general handling of grain and with some of the principal cereal laboratories in the country. Unfortunately one error appears in this otherwise admirable review. As it is one which arises from a common misunderstanding and which might, if left uncorrected, contribute further to the general propagation of this misunderstanding, I should like to set it right.

In discussing the problems arising from the general wheat situation, the statement is made: "The Canadian Wheat Board's answer to these technical problems has been to establish laboratories, now under the direction of J. Ansel Anderson ..." This statement is untrue, and arises from a confusion of the Canadian Wheat Board with the Board of Grain Commissioners for Canada. The Canadian Wheat Board has no laboratories and is a *marketing board* set up under an act of the Canadian Parliament "for marketing in an orderly manner in interprovincial and export trade, grain grown in the designated area" (at present Western Canada). This board assumed complete control of marketing Western Canadian wheat in 1943. The Board of Grain Commissioners for Canada is set up under the Canada Grain Act to administer the grading and handling of grain. Accordingly, in very general terms, the Board of Grain Commissioners is responsible for the quality and "honest weight" of grain, while the Canadian Wheat Board is responsible for general movement and sale of grain. Of the two organizations, the Board of Grain Commissioners is much the older. One of the branches of the Board of Grain Commissioners is the Grain Research Laboratory (Cereal Sci. Today *2*:106; 1957) which was established in 1912 and is the principal Canadian government laboratory dealing with the quality of cereals. As the Boards serve complementary functions, there is close cooperation between them; thus on questions of quality of grain the Wheat Board often consults with the Grain Research Laboratory of the Board of Grain Commissioners, but it has not set up a laboratory of its own to deal with such matters. The present director of the Grain Research Laboratory is Dr. J. Ansel Anderson.

G. NORMAN IRVINE

Grain Research Laboratory,
Winnipeg, Manitoba

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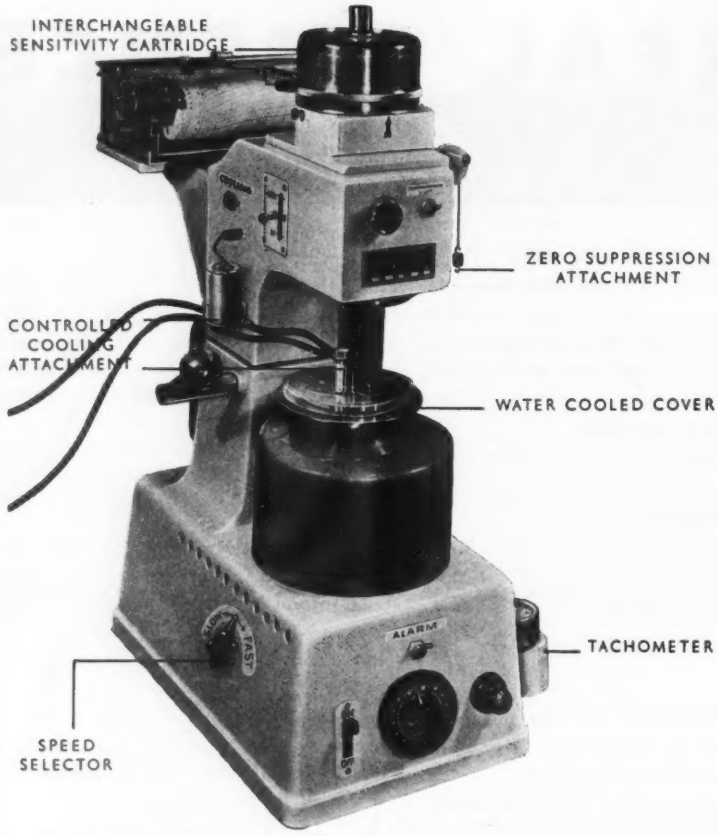

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Editorial

SANITATION HAS BEEN described as a state of mind. What were considered good sanitation standards and practices fifty years ago would not now be acceptable in most food industries. Today's best is likely to be obsolete a few years from now. Sanitation in food processing and handling has moved beyond the public health requirements that once provided the chief impetus for improvement. While food poisoning of various types and the spread of disease through food supplies must always be guarded against, sanitation now serves other purposes as well.

Adherence to high sanitation standards will affect plant and equipment design, raw material selection and handling, packaging, and merchandising methods. Even the selection and training of personnel may be dictated, in part, by these requirements. All these may bring about an apparent increase in costs, but there are compensating economic factors, some more tangible than others. Spoilage losses in processing and in distribution channels are reduced. Uniformity of quality is improved. Consumer acceptance of products grows. A company's reputation among its customers, employees, and regulatory officials is enhanced.

In times past, notable differences have existed with respect to the amount of attention given to sanitation in various types of food processing. The nature of their raw materials, processing methods, and products was usually such that cereal processing industries could get by with minimum concern over sanitation. This has changed. Human effort is wasted when used to produce grain or grain products that are consumed or damaged by rodents, insects, or microorganisms. Esthetically, we rebel at eating what these predators have left, even though it may be physiologically innocuous. Filth is objectionable, even when it is harmless to health.

An awareness and understanding of the problem, together with new tools and methods, is raising sanitation standards in cereal products to new highs. Along with this, these products are finding new markets in an ever-increasing number of new foods.

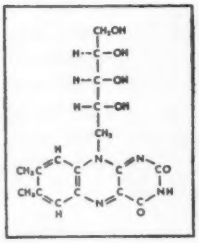
P. E. RAMSTAD

The Vital Story

A Quick History. Independent investigators, working separately to unlock several of nature's doors, sometimes open up unsuspected relationships. This happened with vitamin B_2.

Investigations. About 25 years ago, several groups, notably Warburg's, were investigating a "yellow enzyme" obtained from yeast. Almost simultaneously other investigators were studying a food factor that aided growth of laboratory animals.

What they found. Proceeding with chemical analysis of this growth factor, the team of Kuhn, György, and Wagner-Jauregg noted a relationship between the growth-producing agent and the "yellow enzyme." Their findings, and those of other researchers along similar lines, were published in 1933. Eventually, riboflavin and an essential part of the yellow enzyme were found to be identical and the unity of an essential nutrient and cellular metabolism was established.



Isolation of pure riboflavin was achieved by Kuhn and his co-workers, and by Ellinger and Koschara, in 1933.

Nomenclature. Known in the United States as riboflavin, this vitamin has also been called lactoflavin, ovoflavin, hepatoflavin, and vitamin G.

SYNTHESIS

By 1935, two eminent chemists, working separately, had synthesized riboflavin, practically in a dead heat. Prof. Paul Karrer of the University of Zurich, a collaborator of the Hoffmann-La Roche Laboratories, produced the first successful synthesis. Five weeks later Richard Kuhn of Germany announced his synthesis of the vitamin. Prof. Karrer subsequently shared the Nobel Prize in Chemistry for his work in vitamins and carotenoids.

The Karrer synthesis forms the basis for chemical processes in widespread use today by Hoffmann-La Roche and other leading manufacturers throughout the world. Riboflavin is also manufactured today by fermentation methods.

CHEMICAL AND PHYSICAL PROPERTIES

Riboflavin is yellow, slightly water-soluble with a greenish fluorescence and a bitter taste. Its empirical formula is $C_{17}H_{20}N_4O_6$. Vitamin B_2 produced by the Roche process is identical in every way with that occurring in nature.

How does vitamin B_2 work? Riboflavin is a vital part of nature's chain of reactions for utilization of carbohydrate energy. It has been found to be a constituent of many enzyme systems and is thus intimately connected with life processes. It is probably required by the metabolic processes of every animal and bird as well as by many fishes, insects and lower forms of life. (In certain animals, however, the requirement may be synthesized by bacteria within the intestine.)

In the cells riboflavin goes to work attached to a phosphate group. This substance, known as riboflavin-5′-phosphate or flavin mononucleotide, may in turn be attached to still another essential substance, adenylic acid, forming flavin adenine dinucleotide. Either nucleotide then is attached to protein, thereby forming an enzyme, and takes its part in oxidation-reduction reactions.

Requirements in Human Nutrition. As we have seen, vitamin B_2 is essential to life. We have no special storage organs in our bodies for this vitamin, although a certain level is maintained in various tissues, with relatively large amounts found in the liver and kidneys.

MEASURING METHODS

In the beginning, riboflavin activity was described in "Bourquin-Sherman units" and requirements were thought to be very small. Subsequent research showed otherwise. Milligrams of weight became the unit and the Food & Drug Administration of the U. S. Dept. of Health, Education & Welfare established (July 1, 1958) a minimum daily requirement of 1.2 mg. of riboflavin for all persons 12 or more years old. For infants it is 0.6 mg. These requirements are designed to prevent the occurrence of symptoms of riboflavin deficiency disease. The minimum daily requirement for this vitamin for children from 1 to 12 years is 0.9 milligram.

Recommended allowances. The Food & Nutrition Board of the National Academy of Sciences—National Research Council, in its 1958 publication #589, recommends the following daily dietary allowances of riboflavin, expressed as milligrams. These are designed to maintain good nutrition of healthy persons in the U.S.A.

Men	1.8	
Women	1.5	
Women (pregnant; second half)	2.0	
Women (lactating)	2.5	
Infants (2 to 6 months)	0.5	
Infants (7 to 12 months)	0.8	
Children (1 to 3 years)	1.0	
Children (4 to 6 years)	1.3	
Children (7 to 9 years)	1.5	
Children (10 to 12 years)	1.8	
	Boys	Girls
Adolescents (13 to 15 years)	2.1	2.0
Adolescents (16 to 19 years)	2.5	1.9

# of VITAMIN B_2 *by* Science Writer

(Riboflavin)

Deficiencies of vitamin B_2 appear in several ways in human beings. The eyes, the skin, the nerves, and the blood show the effects of too little riboflavin. Laboratory animals have demonstrated that a riboflavin-deficient diet can cause death of adults and can slow or stop growth in the young. Female animals, deprived of riboflavin in the diet, may produce offspring with congenital malformations.

Medical uses. To overcome and control deficiencies in human beings, physicians have pure riboflavin available for administration by injection or orally, by itself or with other "B" vitamins or multi-vitamin-mineral combinations.

How do we get our daily riboflavin? Vitamin B_2 has wide distribution throughout the entire animal and vegetable kingdoms. Good sources are milk and its products, eggs, meats, legumes, green leaves and buds. Whole-grain cereals have significant but not large amounts of riboflavin.

ADDITION TO FOODS

Cereal foods play a large part in our diet. To produce the white flour almost all of us want, millers are obliged to remove parts of the wheat that contain much of the grain's riboflavin and other nutrients. In addition, cereal grains are not rich sources of riboflavin. Millers meet this problem by *enriching* the grain foods for which federal standards exist with vitamins B_1, B_2, niacin and the mineral iron. In the case of vitamin B_2, however, they do more than *restore* the processed food to its natural riboflavin level; they *fortify* the food with enough of this essential vitamin to make it nutritionally more valuable than it was in nature.

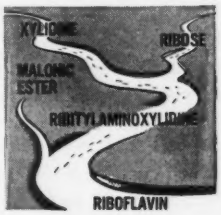
Acting to protect the good health of millions of Americans, bakers and millers adopted *enrichment* of white bread and white flour in 1941. Since that time, other foods, such as macaroni products, corn meal and grits, farina, pastina and breakfast cereals have had their food value increased by enrichment with pure riboflavin and other vitamins and minerals.

When enriching, fortifying or restoring, food manufacturers add the necessary quantity of riboflavin (and other vitamins and minerals) to the food during processing, so that the finished product meets federal, state, and territorial requirements or contributes to the consumer an amount of the vitamin that dietary experts believe significantly useful.

PRODUCTION

Prof. Karrer's synthesis of riboflavin was a laboratory success. Adapting the process to commercial production, however, demanded original thinking by chemists at Hoffmann-La Roche. The production of riboflavin by chemical synthesis requires the production of ribose, a rare sugar, at an early stage in the process. This special sugar must be made inexpensively if the synthesis is to be practical. Sugar chemistry is a difficult matter. In a brilliant piece of work, the Roche chemical experts developed a method to produce ribose on a commercial scale by an electrolytic process, thus overcoming a most troublesome problem. Subsequently, Roche chemists developed the first practical synthesis for riboflavin-5′-phosphate, identical with natural flavin mononucleotide.

Picture three streams joining to form a river and you have a simplified idea of the Roche process for synthesizing vitamin B_2. O-xylene and glucose are processed separately to form xylidine and ribose respectively. These are joined to form ribitylxylidine, which is then converted to ribitylaminoxylidine. Starting separately with malonic ester, which is processed through intermediate stages to alloxan, the third "stream" is then joined with ribitylaminoxylidine to form riboflavin. Purification occurs at each step of the synthesis. Riboflavin Roche* equals or exceeds U. S. P. standards.



By the tons. So efficient is the Roche process that pure riboflavin is produced *by the tons* for use in pharmaceutical products and processed foods. An interesting development by Roche is the production of riboflavin in different forms related to the method of end use. Roche*Regular riboflavin U. S. P. is especially useful in dry enrichment premixes, powdered dietary supplements, pharmaceutical tablets and soft gelatin capsules. Roche*Solutions type is preferred for the manufacture of solutions having low concentration. Roche* Riboflavin-5′-Phosphate Sodium is a highly and rapidly soluble riboflavin compound favored for all pharmaceutical liquid products and some tablets, lozenges, and capsules. It has a more pleasant taste than the bitter U. S. P. riboflavin.

This article is published in the interests of pharmaceutical manufacturers, and of food processors who make their good foods better using pure riboflavin Roche.* Reprints of this and others in the series will be supplied on request without charge. Also available without cost is a brochure describing the enrichment or fortification of cereal grain products with essential vitamins and minerals. These articles and the brochure have been found most helpful as sources of accurate information in brief form. Teachers especially find them useful in education. Regardless of your occupation, feel free to write for them. Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada: Hoffmann-La Roche Ltd., 1956 Bourdon St., St. Laurent, P. Q.

HOW TURBO-MILLING MAY AFFECT THE WHEAT BREEDER

Soft Wheat Quality: the Trade Viewpoint

By R. K. Durham, Technical Manager, Flour Quality Control Department, The Pillsbury Company, Minneapolis, Minnesota

MOST OF THE soft wheat flour milled today finds its way into biscuits, cookies, cakes, or crackers. It is too much to expect that any one wheat variety will yield flour ideally suited for all uses. Generally speaking, however, the predominant soft red winter wheat varieties grown here in the Midwest are satisfactory from a milling and baking point of view.

At the same time, there are variations from one crop year to another which sometimes result in unsatisfactory baking performance. The current crop, because of predominance of sprouted kernels, is an example. The 1957 and 1956 crops of soft red winter wheat were less desirable for cake-baking purposes than the 1955 crop. No significant shift, however, appears to have been made in acreage seeded to wheat varieties during that period.

Soft wheat breeders should not be confused by those in the milling and baking industries who demand new varieties simply because any current year's crop possesses some relatively undesirable characteristics. What is needed more than new varieties in such a year is greater fundamental knowledge to explain *why* flour from that year's crop performed differently. It is gratifying to note that the Soft Wheat Quality Laboratory at Wooster is making satisfactory progress toward supplying that fundamental knowledge.

Soft and Hard Characteristics

In these remarks, expressions like "softness" and "hardness" will be used. Let me explain what is meant by those expressions, in relation to certain tests now in use at the Wooster Soft Wheat Quality Laboratory.

The pearling test is one measure of what is referred to as softness. The greater the pearling index, the softer the wheat kernel texture.

Particle size index, as determined in the Wooster Laboratory, is another good measure of wheat softness. Later on, particle size will be discussed from a different viewpoint.

Amount of break flour released during the Allis-Chalmers experimental milling test also indicates degree of wheat kernel softness.

Of the baking tests employed, the cookie test is a good indication of softness or hardness. The alkaline water retention capacity of flour, which William T. Yamazaki has shown to be related to cookie spread, also indicates degree of softness.

Protein content has ceased to be a reliable measure of softness.

At this point it will be clear what is meant by the statement that the milling and baking industries will approve if the soft wheat breeder, when in doubt, inclines toward softer characteristics. It is very probable that in the foreseeable future an ample amount of soft wheat of the harder type will be grown, so that the miller can make wheat blends to yield harder-type flour if he so desires.

Needs and Preferences of Bakers

The cookie baker who wants maximum cookie spread prefers flour possessing very soft characteristics. Soft white wheat flour produces cookies with generally greater spread than does soft red winter wheat flour. The baker of spread-type cookies is, therefore, not dependent upon soft red winter wheat flour.

The cracker baker prefers a flour that is as hard as the hardest soft wheat flour and preferably somewhat harder. It is quite common to blend some low-protein hard wheat with soft red or soft white wheat to produce cracker flour.

Flour preference for use in chemically leavened biscuits is an indeterminate thing. Satisfactory biscuits are made from a wide variety of flour types — even hard red winter wheat flour. The wheat breeder need, therefore, give little or no thought to biscuit-baking performance.

This brings us to consideration of the fourth and, from the standpoint of size of market, the most important soft wheat flour use; namely, cake baking. For the most satisfactory cake-baking performance, the flour should be milled from wheat that is intermediate on the softness scale between that which is best suited for spread-type cookies and that preferred by the cracker baker.

Considering the rather wide range of softness required to satisfy the baker of spread-type cookies and the cracker baker, as well as the intermediate softness preferred by the cake baker, it seems unreasonable to expect the wheat breeder to develop a soft wheat variety that will satisfy all three bakers. Here perhaps the opening statement may be repeated: that, generally speaking, the predominant soft red winter wheat varieties grown in the Midwest are satisfactory from a milling and baking point of view.

The Turbo-Milling Process

A novel milling process has been developed recently that will somewhat lessen the pressure on the soft wheat breeder, because he may now devote a little less attention to milling and baking characteristics of varie-

ties. This is the turbo-milling process.

This new process involves the reprocessing of conventionally milled flour. There are two steps: 1) average particle size of the flour is reduced, and 2) the flour particles are classified into fractions according to size, shape, and density. Particle size is reduced essentially by attrition. By this method of disintegration, starch granules are not damaged, as they would be by shearing action if reground in a roller mill.

Conventionally milled flour is a heterogeneous mixture of particles varying in size from approximately 1 to 150 microns, and further subdivision, by normal sifting methods, is not practical. But with the use of air-classifiers, conventionally milled flour can be fractionated into several component parts, each part being made up of particles falling within a narrow size range, such as 0–10, 10–20, or 20–30 microns. Air-classified particles larger than approximately 50 microns are often referred to as endosperm chunks. They are tiny bits composed of protein and starch and some lesser constituents cemented together in the same proportions as they exist in the natural wheat kernel. There appears to be no good reason to classify them further into more particle-size fractions, because they are all similar to the parent flour in protein and starch content as well as baking performance.

Products of Turbo-Milling

During the normal wheat-to-flour milling process some of the endosperm disintegrates into particles of almost pure protein and pure starch. The protein particles range from approximately 0 to 15 microns. Starch granules fall into the approximate range of 15 to 30 microns. The turbo miller is able to separate from normal soft wheat flour containing 8.0% protein a commercially practical percentage of very small particles that analyzes 20–25% protein ($N \times 5.7$). This fraction is now on the market. It is used to fortify bread flour where added baking strength is needed. It is also used in specialty high-protein breads. By means of reclassification the protein concentration can be increased to 35 or 40%, but this is not practical. The remainder of this smallest-size fraction consists of tiny starch granules, chips from larger starch granules, fat, fiber, and lesser, unidentified material.

The next larger particle-size cut is composed, chiefly, of relatively small starch granules. From turbo-milled soft wheat flour this fraction will contain approximately 5.0–6.0% protein. It is an excellent flour for angel-food cake, and performs very well in high-ratio cake formulas and in cookie doughs. With further reprocessing of this fraction, it is possible to obtain a cut containing only 2.0–3.0% protein.

Going a step further up the scale, the next larger particle-size cut contains large starch granules mixed with considerable small endosperm chunk material. If soft wheat flour has been the parent stock, this fraction will contain about 7.0% protein and is a satisfactory flour for use in high-ratio cake formulas.

It is obvious from the foregoing that the turbo miller can make several critical cuts or combinations of fractions to yield types of flour best suited for specific purposes. Furthermore, he is not nearly so dependent upon Mother Nature as he formerly was. He can remove more or less protein. He can remove more or less starch. He can modify baking performance, within limits, by further particle-size reduction in the turbo system.

The turbo-miller is now deriving from hard red winter wheat a starchy fraction containing approximately 6.0–7.0% protein, which he is selling to commercial cake bakers to take the place of soft wheat cake flours. This fraction performs very well in high-ratio layer cakes, in loaf cakes, and in angel-food cakes. Although the cakes are not quite as tender as those made from soft wheat flour, they will stand the rougher handling to which bakery cakes are subjected. And in addition, the cakes have whiter crumb and larger volume than those made from soft wheat flour. Because of greater liquid-carrying capacity, the yield of baked products is greater.

Turbo-Milling and the Wheat Breeder

Other things such as test weight per bushel and baking performance being equal, the turbo-miller prefers wheat kernels that are relatively less vitreous. The endosperm of such kernels more readily disintegrates into pure protein and pure starch particles during normal milling. The turbo-miller can, however, mellow the most vitreous kernels ahead of the milling process, although this may sometimes require unusual tempering or conditioning steps. The wheat breeder should therefore not be concerned with kernel hardness insofar as this property affects milling performance.

A final word about turbo-milling: The milling and baking industries do not wish the wheat breeder and agronomist to feel that inherent milling and baking properties of wheat varieties are no longer important. Although the turbo-miller *can* upgrade baking performance, he much prefers to start with the best possible raw material.

A FOOD CHEMIST REVEALS

New Aspects of an Old Sugar—Lactose

By J. V. Reger, Western Condensing Company, Appleton, Wisconsin

FOOD CHEMISTS HAVE shown a keen interest in lactose during recent months, but available literature is limited largely to its manufacture, nutritional properties, solubility, and basic chemical reactions. This discussion will be concerned mainly with the unique physical and chemical properties of lactose, along with some comments on how food chemists have taken advantage of these particular properties to develop new products or improve existing ones.

Manufacture and Marketing

Because of excellent and recent reviews dealing with the manufacture of lactose (7, 8, 10, 11), general remarks should suffice for this phase of the subject.

The chief source of lactose is cheese whey. There are many modifications of the over-all process for its manufacture, but as a basic procedure, whey is concentrated to the point where lactose will crystallize, and then this crude lactose is further refined in much the same manner as other common sugars.

In one process commercially used, fluid whey is preheated and concentrated in quadruple-effect evaporators to approximately 30% solids; after further heating and concentrating to slightly more than 50% solids, the concentrate is placed in stainless-steel agitator-equipped tanks and cooled, by means of carefully controlled techniques, to induce crystallization. The crude lactose is centrifuged, washed, and redissolved in water, and then treated with activated carbon to decolorize the solution. It is then filtered, concentrated, spray-dried, and packed in multiwall paper bags, polyethylene-lined, or in fiber drums, also polyethylene-lined.

Yields of lactose by this method are relatively low, but the by-product is an excellent feed-grade whey having considerably more protein than regular dry whey. For higher yields the proteins often are removed prior to crystallization. Commercially, all lots are tested to ensure that the rigid specifications for ash, moisture, acidity, color, flavor, odor, bacteria, extraneous matter, and particle size are met.

In a recent article, M. E. Hull (7) estimated that there are approximately ten billion pounds of fluid whey available, containing roughly 5% lactose, or a potential supply of nearly 500 million pounds. In 1955 production of lactose was estimated at 35 million pounds, approximately 7% of the available supply. A significant portion of the whey is used to produce food-grade dried whey and dried and condensed feed-grade whey products. The total outlet for lactose and the food- and feed-grade whey still leave the majority of the fluid whey as a disposal problem for the dairy industry. This is of definite concern, and consequently some investigations are going on, designed to develop new outlets for whey. Since lactose represents a substantial part of the solids (72–73%), new outlets for lactose also would do much to alleviate the problem of whey disposal, as well as utilizing much of the valuable nutritive solids in whey.

One of the major steps taken to encourage greater utilization of lactose was to make it available at an economically suitable price. While the price of edible or food-grade lactose decreased appreciably in recent years, it still is priced somewhat higher than the other common sugars. Current quotations list lactose, food grade, at 14¢ per pound f.o.b. manufacturing plant in truckload or carload quantities. Because this is higher than other sugars, lactose must rely upon its unique physical and chemical properties to bring about certain advantages from a functional standpoint and thus justify its use. Fortunately for lactose, it has both functional properties and nutritional merits of sufficient value to interest many food producers, and certain promotional advantages for products in which it is used have proved to be attractive. From here on this discussion will deal primarily with these particular physical and chemical properties and nutritive values. Possible promotional advantages of lactose will become apparent as the report continues.

Properties Are Put to Work

As indicated earlier, available literature does not give detailed information on the properties of lactose, and experimental data are sadly lacking. The examples cited, in which these properties are used to advantage, are based principally on field experience.

Having a relatively low sweetness value — 16 as compared to 100 for sucrose — lactose has been used to reduce the excessive sweetness of some icings and certain pie fillings and to improve the flavor. As a sugar it is a tenderizer, and considerably higher levels can be used for tenderizing without causing excessive sweetness.

Lactose is nonhygroscopic and thus can serve as an anticaking agent and dispensing aid in powdered products. Many items dispensed in vending machines include a definite concentration of lactose to maintain the product in a free-flowing condition. In addition, it is completely soluble,

and does not influence sweetness. Among food processors that have taken advantage of its low sweetness and free-flowing characteristics are manufacturers of dried soups, powdered coffee creams, powdered fruit drinks, and spice mixtures.

Solubility

The solubility properties of lactose are somewhat different from those of the other common sugars. For example, at 0°, only 5% of lactose is soluble in 100 ml. of water, but at 25°C., 8.6 g., and at 64°C., 26.2 g. can be dissolved in 100 ml. of water. It also dissolves less rapidly than the other sugars. For this reason it is used to coat many products, including fats, to improve wetting and dispersing properties of the finished products.

In combination with other sugars, lactose alters the behavior of the other sugars as to crystallization, and often is used to control crystallization. A common method is to seed the sugar mixture with finely pulverized lactose to force crystallization and thus avoid crystal growth and grittiness or sandiness. Part of the success of powdered coffee creams lies in the ability of lactose to improve wetting and dispersing properties. When crystallization is controlled in fudge by lactose seeding, it has excellent body and texture and longer shelf-life.

Pigment Absorption

Lactose has the ability to absorb pigments, and claims have been made by commercial processors that it is superior in this to other sugars. This ability, plus the fact that it does not go into solution as rapidly, means better distribution of color throughout a mix. Apparently, when color is absorbed onto a much more soluble sugar, the colored sugar dissolves immediately, leaving tiny concentrated droplets of color which must be agitated vigorously to be thoroughly and uniformly distributed throughout the mix or solution. The slower solubility of the lactose product means the color is released more gradually and no concentrated droplets are formed. These features are important to manufacturers of colored puff paste, colored icings, and Easter-egg dyes. Even things so remote from food as colored plaster and cement are improved with dyes absorbed on lactose, in that mottling and off-shading are avoided.

Flavor Enhancement

Because lactose will absorb aromas and flavors more tenaciously than other sugars, it serves as an extender for many spices and volatile aromas. Whether or not there is specificity for certain flavors or aromas has not been investigated. At one time, manufacturers of instant coffee found that if during the evaporation process they passed the gases through lactose, it absorbed many of the volatiles normally lost and, when added back to the powdered coffee, gave superior flavor to that of the pure coffee. It is understood that many institutional coffee blends of the instant variety include lactose in processing. Again, the relatively low sweetness means no interference with the fine flavor of the finished product.

Lactose is known to be particularly effective as a flavor enhancer in products such as barbecue sauces, dressings of the French, Thousand-Island, and Roquefort types, fruit drinks, pie fillings, and puddings. In dairy drinks such as chocolate drink, for example, it is possible to reduce butterfat content from 2 to 1%, add 1% lactose, and obtain apparently the same richness of flavor. Pie crusts in which butterfat is a part of the shortening have a more pronounced butterfat flavor when lactose is used. Nearly all flavors appear to be enhanced by lactose—a disadvantage, of course, if off-flavors are present, since these too will be more pronounced.

Lactose in Baking

Lactose is a reducing sugar made up of glucose and galactose. Like other reducing sugars it enters readily into the Maillard reaction in which the reducing sugar reacts with amino acids to form compounds (melanoidins) which are highly flavored and golden brown in color, commonly found in the crusts of many baked foods. A solution of two parts of lactose and one part of glycine sprayed onto products which are baked by infrared rays, we are told, will produce a very attractive and appetizing golden-brown crust color. Lactose also undergoes caramelization under the influence of heat, which again contributes to both the flavor and color of baked products.

Lactose is not fermented by ordinary baker's yeast and is, therefore, available for tenderizing and color formation during the baking process. The fact that lactose is not fermented by certain yeasts and some other microbial cultures makes it possible to preserve these particular cultures in a viable state. Usually 10 to 20% lactose will preserve yeast and yet, when it is added to a suitable medium such as molasses, fermentation will begin very quickly, with minimum lag (9).

Because lactose is not hydrolyzed by baker's yeast, its functional properties are effective throughout the baking process. Experience in actual plant production has shown that 3 to 4% lactose (flour basis) in bread and rolls will produce whiter crumb, finer grain and texture, and more distinctive golden-brown crust color than when cane and/or corn sugar is the only sugar. Machining properties of lactose doughs are excellent. Lactose improves moisture retention, shelf-life, and softness, but to date no adequate statistical data are available to establish the degree of significance to which these properties are influenced. Tolerance to mixing, to floor time, and to variable oven conditions is increased. The above comments seem to apply even though lactose may be present in nearly equivalent quantities from the milk powders used.

Lactose has emulsifying properties which allow greater efficiency from the shortenings used, resulting in more uniform cell structure and richer flavor. This functional property is important to pie bakers because it means maximum distribution of the shortening with minimum mixing. Pie doughs with 8% lactose (flour basis) are more tender and shorter after both mixing and baking; they sheet out better and retard or shrink less after sheeting and during baking; and there is less tendency for the crust to become soggy throughout or in spots. Tolerance to mixing is higher, and changes in the temperature of dough ingredients or a change of mix operators has less effect on the condition of the dough.

These emulsifying properties of lactose are important to the cake baker also; they improve creaming of cake batters, resulting in better volume, grain, and texture. A 10 to 15% level of lactose (sugar basis) is recommended. In rotary-cut cookies using lactose at 3 to 4% (flour basis), the dough releases more readily from the dies and yet the cookies maintain their shape properly during baking. Richness of flavor is more pro-

nounced in both cakes and cookies containing lactose, over and above that provided by the milk powders.

When 15 to 20% of the sugar is replaced by lactose, custards and cream fillings of pies are smoother, more tender, and richer-tasting. The emulsifying properties of lactose appear to retard weeping.

Varied Uses

Weisburg (10), in a recent review of the uses of lactose, cites an Austrian patent in which it was claimed 1 to 3% of lactose in butter materially increased stability and improved flavor. Powdered coffee creams which contain a relatively high percentage of butterfat and lactose also have excellent keeping qualities.

This review (10) mentioned several foreign and domestic patents outlining methods in which lactose was used to produce caramel color and to control crystallization or sandiness in sweetened condensed milk. The techniques involved in controlling sugar crystallization in concentrated milk products were the subject of a recent paper by Doan (5). The functional principles here would certainly apply to products other than milk products —for example, icings, fondants, and fruit preserves. In the latter, lactose has been used advantageously to produce superior flavor and retain the original fruit color. Sandiness developed in the experiments with preserves; however, it was felt that it could be controlled by "seeding" with lactose to force crystallization and govern the size of the crystals formed.

Experiments by Dawson and Wood (4) showed that lactose improved both baking and keeping qualities of spray-dried whole egg. Control samples at 100°F. retained good properties only one week, whereas those containing 10% lactose maintained the sample for 8 weeks in good condition. For the same effectiveness with sucrose, a 20% addition was required.

Many of the applications mentioned above may be of little interest to cereal chemists; however, the examples cited serve to illustrate the functional properties of lactose and how they can be applied.

Other uses for lactose include those in the production of fireworks to govern the rate of burning; for silvering mirrors; and as an ingredient in toothpastes to provide a polishing action without leaving an insoluble residue. Here, lactose, it was claimed, promotes the growth of microflora antagonistic to the acid-forming bacteria which produce cavities (10). For many years, lactose has been used as a filler and excipient in pharmaceutical tablets and capsules.

Nutritional Merits

One of the oldest uses for lactose is in the production of simulated mother's milks or infant food formulas. Mother's milk contains nearly 50% more lactose than cow's milk, and in the simulated products the lactose level is raised to that extent. While the physiological value of lactose has been a subject of much controversy among various pediatricians, it is the consensus that Mother Nature was wise in her choice of lactose and that it has nutritional benefits not enjoyed by other carbohydrates.

The nutritional merits of lactose have been well substantiated and rather thoroughly investigated. Yet, as is the case with many products of long standing, the need for a great deal more research work has been pointed out by investigators. In 1955, Dorothy L. Duncan (6) published an excellent review on the physiological effects of lactose. In 1957, Atkinson *et al.* (1) reviewed the nutritional aspects of lactose in animal and human feeding. Both reviews are excellent and give a large number of references. Lactose is known to be influential in regulating the blood levels of calcium, phosphorus, and possibly magnesium. It is required for proper deposition of calcium and phosphorus to the bone. Because lactose is hydrolyzed slowly in the intestinal tract, it could be considered a source of sustained energy versus the quick energy obtained from dextrose intake. Lactose is made up of glucose and galactose. Galactose has been described as the "structural" sugar necessary for the repair and development of brain tissue, mucous tissue, and other delicate tissues. There has been some evidence that lactose is nonglycogen-forming, although this has not been substantiated adequately to cause nutritionists to agree. Lactose seems to be tolerated at higher levels by diabetics, and many commercial diabetic ice creams contain substantial quantities of it. For many years it has been used as a digestive aid, because it favors the production of acid-forming microorganisms. Consequently, both young and old can favorably tolerate relatively high levels of lactose. Results obtained in recent studies at the Pennsylvania School of Medicine strongly indicate it improves nitrogen retention by the body (2,3), seemingly as the result of better absorption of the protein rather than any differences in protein metabolism.

The nutritional benefits mentioned above, combined with its functional values, have placed lactose in a prominent place on the ingredient shelf of many food chemists. As they continue to develop new products and improve existing ones, more new uses for lactose will appear, and more information on its physical and chemical properties will be made available.

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BAKING NEWS FROM Pfizer

Quality Ingredients
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NEW INTEREST IN GLUCONO-DELTA-LACTONE AS ACIDULANT IN "INSTANT" DOUGH MIXES PERMITS BREAD PRODUCTION IN 50 MINUTES INSTEAD OF 5 HOURS.

Currently, the baking industry is evaluating new chemical leavening systems which contain glucono-delta-lactone. Following the presentation of reports at a meeting of the American Association of Cereal Chemists and Institute of Food Technologists by scientists from the Quartermaster Food and Container Institutes, many companies are evaluating new markets for products containing glucono-delta-lactone.

The reports deal with an "instant" bread mix containing glucono-delta-lactone as the acidulant. With this mix no conventional yeast fermentation and proofing steps are needed . . . chemical leavening permits production of finished bread in 50 minutes as compared to approximately 5 hours for a yeast-leavened loaf. The bread has standard shape, color, grain and texture. Moreover, this bread does not have the objectionable aftertaste found with some leavening salts.

In addition to its use in bread mix, glucono-delta-lactone has proven effective as the acidulant in prepared cake mixes, angel cake, pound cake, biscuits and roll mixes. In laboratory evaluations, Pfizer Technical Service found that the slow hydrolysis rate of glucono-delta-lactone in cold water coupled with an increased hydrolysis rate at elevated temperatures make it an excellent acidulant for baked products which can utilize a chemical raising action.

Fumaric Acid & Cream of Tartar

Other interesting Pfizer acidulants for use in chemical leavening systems are fumaric acid and cream of tartar. Both of these products have limited solubility in cold water which inhibits the reaction with bicarbonates with a resulting small evolution of gas during initial stages of mixing. An increase of solubility at elevated temperatures results in major carbon dioxide evolution at baking temperatures.

New Pfizer Sorbistat®-K

Sorbistat-K overcomes the problem of water solubility of sorbic acid. Up to 40% solutions can now be prepared rapidly by simply dissolving in water. Because of this improved solubility many companies have found in recent experience that the new potassium salt has proved more effective than the acid.

Both Sorbistat (sorbic acid, Pfizer) and its water-soluble potassium salt, Sorbistat-K (potassium sorbate, Pfizer) are effective growth inhibitors for many yeasts and molds which cause spoilage of baked goods.

Generally, Sorbistat and Sorbistat-K are effective at pH 2.0-7.0. In the baking industry, Sorbistat-K is the product of choice in chemically-leavened baked products due to its wide range of effectiveness at comparatively low levels.

Extensive laboratory evaluations have shown Sorbistat-K to be usually effective at approximately one fourth the level of propionate and at about one third the level of benzoate. In addition, at practical use levels Sorbistat-K does not impart any off-flavor to the food product.

Specifically, Sorbistat-K has proven effective in chocolate cake, pound cake, yellow cake, white cake, cheese cake, angel food cake, fruit cake and marble cake. It is also of value in many pies, filled sweet goods and cookies. The exact level of use will vary with the type of food, degree of protection needed and the amount of contamination present.

Sorbistat-K, because of its excellent water-soluble properties, can be added directly to batters in the dry form or as a water solution of potassium sorbate. If you would like further information on glucono-delta-lactone, fumaric acid, cream of tartar or Sorbistat-K, write CHAS. PFIZER & CO., INC., Chemical Sales Division, 630 Flushing Avenue, Brooklyn 6, New York. Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Texas.

IMPORTANT NEW PROJECTS DISCUSSED AT THE

Wheat Utilization Research Conference

THE DISCOVERY OF four major components in gluten, the principal constituent of wheat protein, and a summary of bread-staling studies were among fundamental and applied research reported at the third annual Wheat Utilization Research Conference September 30 and October 1, held at Peoria, Illinois.

Attended by about 100 persons, the conference was sponsored by the Northern and Western Utilization Research and Development Divisions of the Agricultural Research Service, U. S. Department of Agriculture, and the technical committee of the Millers' National Federation.

Utilization Research Outlined

In welcoming the Millers' group, W. D. Maclay, director of the Northern Division, outlined certain responsibilities in cereal grain research at Peoria and at the Western Division, Albany, California. He also discussed the trend, in the over-all picture, of increased interest in utilization research on surplus crops and the recently inaugurated research program in Europe under PL 480 funds.

Responding to the welcome, H. H. Schopmeyer, chairman of the technical committee of the Millers' National Federation, said the annual conferences give industry an opportunity to air problems and view research progress. He pointed to industry's growing interest in the meetings.

F. R. Senti, Cereal Crops Laboratory chief at the Northern Division, outlined the cereal grains research program. "Because of the grain surpluses which have existed for the past several years," he said, "emphasis in our program has been on research directed toward industrial use of grains."

Utilization research includes both product and process development and is supported by a program of more basic studies aimed at the discovery of new products and processes. Three approaches in development of new products are chemical modification, genetic modification in cooperation with plant-breeding scientists, and fermentative conversion.

Analysis and Separation of Wheat Gluten

R. W. Jones of the Northern Division reported that electrophoretic patterns show "gluten of bread wheats is composed of at least four major and one minor component." Previous work in this field has met with little success. Researchers have claimed gluten contained from one to an infinite number of components. Mr. Jones found the relative concentrations of the gluten components to be 44, 22, 16, 15, and 3%; he also found evidence that the 15% concentration includes two components. Small amounts of globulin or albumen, nongluten proteins, showed up in the analyses.

One of the stops on a tour of the Northern Utilization Research and Development Division during the recent wheat research conference was a demonstration of bulgur and pilafs made from it. (Bulgur is parboiled wheat; pilaf an Oriental-style dish prepared from it.) From right, S. J. Loska, Jr., The Pillsbury Company, and John A. Johnson, Kansas State College, sample these foods and discuss their development at WURDD with J. W. Pence of the Western Division.

Chromatographic separation of wheat gluten, reported by J. H. Woychik, Northern Division, produces fractions corresponding to the components found by electrophoresis. Mr. Woychik said, "The availability of wheat gluten fractions corresponding to observed electrophoretic components presents the opportunity for a more definite study of these proteins."

Bread Staling

Starch crystallization is accepted as the main cause of firming that accompanies bread staling. Evidence supporting this is the similarity of X-ray patterns of stale bread and retrograded, or crystallized, starch. H. F. Zobel of the Northern Division reported that there are three general areas of research on starch crystallization in bread staling: use of flours with noncrystallizing starches; inhibiting crystallization by bread additives; and nullifying crystallization effects.

The first area would call for modified flour or flour derivatives such as cross-linked wheat flour, which might slow crystallization. Mr. Zobel said other researchers have inhibited crystallization, but they used water or objectionable chemicals such as aldehydes. Other factors, however, limit the amount of water that may be used in this way.

Mr. Zobel reported research in nullifying the effects of crystallinity by adding heat-stable enzymes to bread dough. The enzyme did not decrease crystallinity. It did, however, cut the starch chains between crystals permitting the crystals to move independently of one another, and thus reduced the bread firmness.

N. W. Taylor reported that heat-gelatinized starch such as that which occurs in freshly baked bread decreases in water-holding capacity with time; but heated, wet gluten appears to change little in its ability to hold water. There was a definite

transfer of water from starch to gluten during bread staling, but the effect of the loss of this lubricant on firmness of starch was shown to be small as compared to that of crystallization.

Freezing of Baked Goods

"Freezing by proper methods and immediately after baking is the only known means whereby a substantial degree of the original quality of baked products can be preserved for more than a few days," stated J. W. Pence, reporting research at the Western Division, Albany, California. Cakes, generally, are less sensitive to freezing-practice variation than breads. Cakes frozen many weeks usually are better than cakes held 24 hours at room temperature. Researchers found that cakes kept best between 0 and −10°F.

The Western Division has studied bulgur—wheat that has been parboiled, dried, and debranned. From bulgur are made poultry stuffings, pilafs (cereal and meat combinations), and other foods for domestic consumption.

Other Western Division research shows that sulfhydryl groups in wheat gluten affect mixing characteristics of flour.

Fresh Bread Aroma

Collection of gases, concentration, separation by gas chromatography, and identification are the steps Irving Hunter outlined in reporting the Western Division's studies of chemical compounds associated with the aroma of freshly baked bread.

In earlier work, Western Division scientists have separated volatile material from bread into 14 different carbonyl compounds. Most of the compounds have been identified. At least three basic compounds have been separated, and one, a secondary amine, has been positively identified. Twenty-nine chemical components that contribute to bread flavor, including acids, alcohols, and esters, have been separated.

Lipids Affect Cookie Spread

Relatively complete removal of lipids from soft wheat flours markedly decreased spread of sugar cookies in Western Division research reported by Dale K. Mecham.

"Because nearly all the recorded observations on lipid effects were concerned with hard wheat flours and bread baking, we were interested in determining what results might be found with a different product baked from soft wheat flours by a much different procedure," Mr. Mecham said. Removal of lipids by petroleum ether or carbon tetrachloride had little effect on cookie spread.

The marked effect came with the more complete removal of lipids by water-saturated *n*-butyl alcohol. When the extracted lipids were restored, cookies baked with the "restored" flour spread normally. Mr. Mecham said further observations showed that "the likelihood of flours being deficient in necessary lipids appears small." When only a third of extracted lipids were restored to flour, cookies baked from the flour spread normally.

The Western Division researchers also observed that several phospholipid fractions from flour, other vegetable phospholipids, and, among several emulsifiers tried, a sucrose fatty acid ester could restore cookie-spread characteristics to extracted flours.

Protease Activity

John A. Johnson of Kansas State College presented a paper, "Effect of Variety and Malting Conditions on Alpha-Amylase and Protease Activity," on research performed under contract with the Northern Division. Objective of the study was to determine whether the activity of protease, an enzyme that breaks down protein, could be increased independently of the activity of alpha-amylase, which breaks down starches.

"Both enzymes increased with germination time during malting," Johnson reported. Protease activity showed a greater response to steep moisture level than did alpha-amylase activity.

"The process of germination and elaboration of enzymes may be accelerated by the use of gibberellic acid," Johnson suggested.

New Gluten Process

Production of dried, vital gluten is possible with the processes developed at the Northern Division and reported at the conference by Roy A. Anderson.

"Wheat gluten is an unusual protein, having many physical and chemical properties not found in any of the other cereal grain proteins," Mr. Anderson said.

The gluten process includes the continuous batter process and an operation for drying the gluten. The batter process yields starch, a soluble fraction, and the gluten. The starch may be fermented or converted to syrup and sugars; the soluble fraction, containing proteins and sugars, may be added to fermentation media.

A continuous pilot plant for carrying out the batter process has been designed and constructed from conventional equipment. The operation of the plant is flexible. The scientists believe that commercial application could be made by a relatively simple scale-up of equipment. Flours milled from different types of wheat have been processed successfully in this plant. In most cases, recovery of protein in the gluten has been greater than 80%, with gluten purity also about 80%.

The batter process is easily controlled and can be carried out with a minimum requirement for labor, power, and water. The cost of processing 1 pound of flour to starch liquor and wet gluten by this method is estimated at 0.27 cent.

Drying the gluten is accomplished by atmospheric drum drying of wet gluten dispersed in dilute acid. Cost of this is estimated at 4 cents per pound of dried, vital gluten.

Wheat Conditioning Review

In a progress report of a literature survey on wheat conditioning for milling, Majel M. MacMasters, Northern Division, said the survey will include more than 650 references to literature published between 1927 and 1957. She said summaries of data in the survey will be classified: Cold conditioning; warm conditioning; hot conditioning (at temperatures above 46°C.); steam conditioning; vacuum conditioning; conditioning by ultrasonic waves, high frequency current, electric condenser, and infrared rays; hygroscopicity of wheat; thermal properties of wheat; and water absorption by wheat.

Dr. MacMasters warned, "All reported benefits should be viewed with reservations, since different workers have almost invariably used different wheats, different details of conditioning, and different methods of evaluating the results. The complete data should be carefully studied by experienced millers before conclusions are drawn."

(Please turn to Page 279)

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(Continued from Page 276)

Penetration of Moisture into the Wheat Kernel

Water enters the endosperm of tempered wheat kernels around the germ first, then at the brush end, and finally from all sides, M. J. Wolf of the Northern Division said, in reporting three methods for determining moisture distribution in wheat kernels. In the iodine sorption method, wheat was tempered by immersion in water or by absorption of 2 to 10% of added water in a closed container. Starch in cut surfaces of the kernels was treated with iodine vapor or by immersion of the surface in mineral oil or silicone solutions saturated with iodine. This procedure revealed the water-entry information and the fact that water was distributed throughout the endosperm within 70 hours.

Other methods reported are interference microscopy and application of tritiated water as a tracer to follow water distribution in the wheat kernel. Tritium, added to water for the tracing, is radioactive hydrogen.

Interference microscopy enables scientists to compute the refractive index of a wheat-kernel slice. Refractive index is an optical property that is known to change with the swelling of fibers and other plant materials following water uptake.

Milling Quality Studies

A better way to determine milling quality of soft red wheat is the object of research performed by R. A. Popham, Ohio State University, under a contract with the Northern Division. Majel M. MacMasters of the Northern Division presented the paper at the conference.

In the research, wheat kernels from varieties of known milling quality were measured for resistance to crushing. The compression test values gave a more stable ranking of varieties from year to year than the Seeborg milling score provides.

These scientists also want to know whether the arrangement of chemical constituents in the whole kernel of wheat is related to milling quality. By staining cross sections of wheat kernels they hope to find differences that may be correlated with milling quality.

In a report of wheat research at the Western Division, J. W. Pence said early results of a comprehensive study indicate there is a correlation between acid-extractable pentosans of Western white wheat and their milling quality. These results confirm earlier, limited comparisons.

Variety Evaluation Studies

L. P. Reitz, Crops Research Division, Beltsville, Maryland, summarized studies on quality evaluation in wheat varieties in twenty states and at four wheat quality laboratories: Pullman, Washington; Wooster, Ohio; Manhattan, Kansas; and Beltsville.

Pointing out that the work is vital to the maintenance and improvement of wheat variety quality, Dr. Reitz said it has resulted in growing of varieties different from those grown only a few years ago; 33 undesirable wheats are no longer grown. These changes, Dr. Reitz added, have been made without disrupting the market.

Among specific projects he reported are milling quality tests; determination of protein in wheats; viscosity studies on wheat; relation of cake and cookie flour fractions to quality; relation between flour particle size and cookie quality; changes in cookies while baking; effect of temperature during wheat-fruiting period; effect of nitrogen foliar sprays on gluten composition and quality; and analysis of ash content of wheat at the Kansas Laboratory.

Optimism in Industry

S. J. Loska, Jr., of The Pillsbury Company, predicted that "the process of milling will go through changes as great in the next [few] years as it has in the past 50 years." He reported on composition and size distribution of flour fractions from Pillsbury's air classification process.

His optimism strengthened that of R. B. Meckel, International Milling Company, who implied that the recent volume drop in bread consumption is only temporary, coinciding with the recession. Mr. Meckel said consumption of only one more slice of bread per person per day in the United States would mean a 20% increase.

"The baking industry is making strides to greater economy through a number of avenues," Mr. Meckel added. "One of these is the bulk handling of ingredients, such as flour, sugar, and shortening."

Discussing other production advances, he said makeup technique has improved in relatively recent years. This has enabled the industry to produce bread with much better crumb characteristics. Improved makeup technique for buns has resulted in efficient, high-speed production.

Under heading of "packaging, distribution, and selling," Mr. Meckel said that "the baking industry is taking better advantage of the possibilities existing in its markets." Hamburger buns, in response to consumer demand, are being marketed all year instead of only in summer. The industry is doing a better job of packaging and is adjusting to get the greatest possible sales volume through various types of retail units such as supermarkets.

"In consumer education, American Bakers Association, in cooperation with American Institute of Baking, has been very active in publicizing the true food value of bread and in eliminating false ideas about bread which are detrimental to the consumption of bread," Mr. Meckel said. "One of their main efforts has been directed toward better exploiting the fact that the baking industry is spending large sums of money to fortify, or enrich, white bread with certain vitamins and minerals which are very important in human nutrition."

Wheat Commissions Represented

In contrast to the optimism of the millers and bakers was the concern of four state wheat organizations about the wheat-surplus problem. Leslie F. Sheffield, Nebraska Wheat Commission chief, said the Nebraska group has been trying to launch utilization projects. The only research now being carried on is a study on feeding wheat to beef cattle. Foreign marketing has been a hope of various state groups for disposal of surplus wheat, but there will be produced this year alone 800 million bushels of wheat beyond domestic consumption.

Walter W. Graber, administrator, Kansas Wheat Commission; M. C. McCormick, a director of the Colorado Wheat Administrative Committee; and Mr. Sheffield pledged their support of the Northern and Western Divisions in, as Mr. Graber expressed it, "anything that will use wheat at home and abroad." Joseph J. Spiruta, manager, Washington Wheat Commission, attended earlier sessions of the conference.

EFFECT OF MALT SUPPLEMENT ON FARINOGRAMS

WILLIAM C. SHUEY, Products Control Department, General Mills, Inc., Minneapolis, Minnesota

SINCE THE INTRODUCTION of the farinograph to the baking industry in 1931, the machine has been used as a tool for testing the physical properties of doughs. The greater usage of the farinograph by the flour milling industry and allied trades necessitates standard techniques for operating the farinograph. Since flour is sold chiefly with a malt supplement added, the question arises, "Does malt supplement have an effect upon the farinograms and, if so, what?" The purpose of this paper is to show some of the effects malt supplements have on farinograph curves.

Experiment

The constant dough weight farinograph test (1) with the 300-g. bowl was used. The malt supplements were flours milled from malted wheat or barley and obtained from American and German sources. The flours to which the supplements were added were ground on commercial (Allis-Chalmers) and experimental (Buhler) mills. The wheats from which the flours were milled were pure varieties of both spring and winter origin and admixtures of pure varieties and/or of winter or spring origin. The wheats were raised during the crop years 1951 through 1958.

TABLE I
EFFECT OF VARIOUS PERCENTAGES OF MALTED BARLEY FLOUR ON FARINOGRAM VALUES

Flour Sample	Barley Malt	Dough Development Time	Stability	Tolerance Index	20-Minute Drop	Valorimeter Value	Absorption
	%	*minutes*	*minutes*	*BU*			
1	0.0	5.5	8.0	40	75	59	63.6
	0.1	5.5	7.5	50	95	57	63.4
	0.2	5.0	6.5	50	105	56	63.1
2	0.0	5.5	11.5	35	45	62	60.0
	0.1	5.5	7.5	50	80	59	60.1
	0.2	4.5	6.5	50	100	54	60.1
3	0.0	9.0	19.5	20	20	78	61.0
	0.1	8.0	13.0	30	40	71	60.8
	0.2	7.0	10.0	30	55	68	60.6

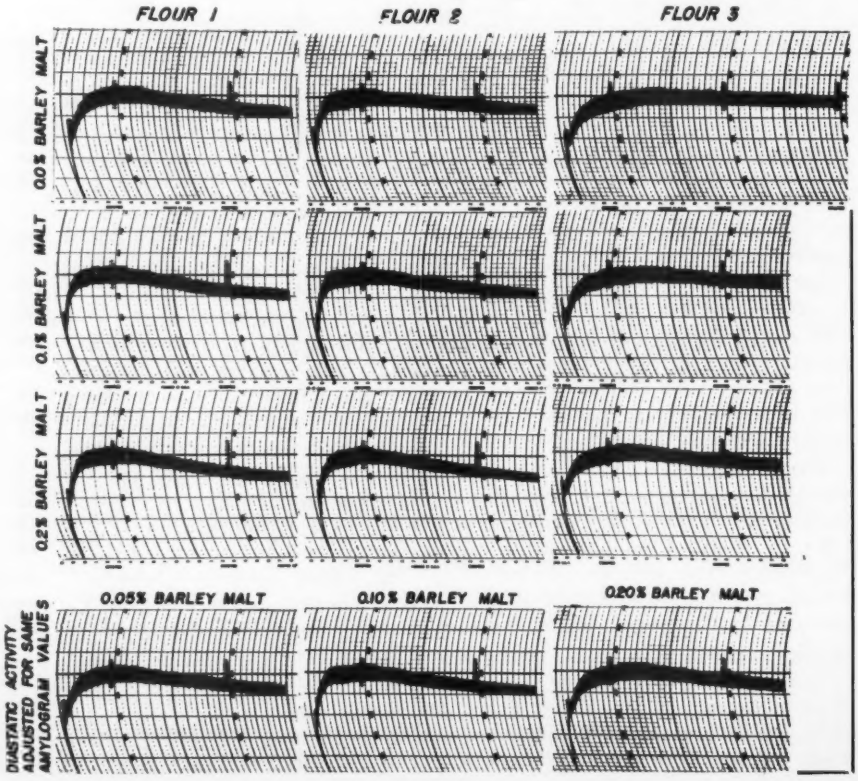
Results

The data and curves shown are representative results. They demonstrate some of the observations made with the addition of malt supplements to unmalted flour.

In the particular series shown, malted barley flour was used. However, malted wheat flour has the same effect. Data for flour 1 in Table I show that dough development time, stability, tolerance index, and valorimeter value are only slightly affected by the addition of malt supplement. For flour 3 the addition of each increment of malt supplement decreases the dough development time, stability, and valorimeter values. For all three flours there is an appreciable effect upon the 20-minute drop. For sample 2 there is little effect on the absorption, whereas for samples 1 and 3 there is a decrease in absorption with each additional increment of malt supplement. The MTI value could either increase or decrease, depending on the effect upon dough development time.

Table II lists the results for the three flours when the addition of the malt supplement has been adjusted to give essentially the same amylograph values. These values are 570, 560, and 580 BU for flours 1, 2, and 3, respectively. (NOTE: It so happens that with this series there is an increase in the amount of supplement needed for all three

Fig. 1. Effect of malt supplement on farinograms.



flours. However, this should not be construed to mean that long-curve unmalted flours need greater amounts of malt supplement. In fact, the reverse could be true depending on the series of samples selected.)

TABLE II
FARINOGRAM VALUES WITH MALT SUPPLEMENT ADJUSTED TO GIVE SIMILAR AMYLOGRAM READINGS

FLOUR SAMPLE	BARLEY MALT	DOUGH DEVELOPMENT TIME	STABILITY	TOLERANCE INDEX	20-MINUTE DROP	VALORIMETER VALUE	ABSORPTION
	%	*minutes*	*minutes*	*BU*			
1	0.05	5.5	8.0	45	80	59	63.3
2	0.10	5.5	7.5	50	80	59	60.1
3	0.20	7.0	10.0	30	55	68	60.0

The curves for 0% barley malt level (Table I) show that there is an increase in the stability of each sample from flour 1 through flour 3. From the curve characteristics the flours could be rated: flour 1, mild to medium; flour 2, medium; and flour 3, very strong. However, when one looks at the curves where the diastatic activity has been adjusted (Table II), the ratings for flours 1 and 2 would be the same — mild to medium; whereas for flour 3 the rating would be medium to strong.

Additional increments of barley malt on flour 1 have little effect upon the farinogram (Fig. 1). However, for flour 3, only 0.1% barley malt showed an appreciable difference in the farinogram values. Therefore, it can be concluded from the data and the farinograph curves that malt supplements can have an effect upon farinograms. This effect is not consistent or uniform and depends entirely upon the type of wheat from which the flour was milled.

Discussion

Moore and Herman (2) showed that malt at 20° and 60° Lintner had similar effects upon farinograms when used in varying percentages. The conclusion is that farinograms for various flours are affected differently with the addition of malt supplement. Since the malt supplement is normally added to commercially milled flours, it is only logical that flours should be tested with a malt supplement added. This would allow for a more accurate comparative evaluation of the flour being tested. An experienced operator formerly was able to estimate what effect a malt supplement addition would have on a farinogram. However, since there are so many more varieties today and the varietal picture is changing so rapidly, it has become almost an impossibility to approximate, accurately and consistently, the effect additions of malt supplement will have on a farinogram.

Literature Cited

1. AMERICAN ASSOCIATION OF CEREAL CHEMISTS. Cereal laboratory methods (6th ed.), pp. 137–139. The Association: St. Paul, Minnesota (1957).
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AACC
LOCAL SECTIONS

Canadian Prairie Section met on October 21 at the Winnipeg Grain Exchange. Members heard a thought-provoking talk by G. S. Baines, Senior Scientific Officer of the Divisional Food Processing Department, India. Mr. Baines described problems involved in the tremendous population increase there and the resultant need for far greater amounts of food. Technologists, he said, are working to find a substitute for rice, which has been the main diet for years but is now too expensive for most of the people to buy. The main work of the DFPD is to develop, from other cereal grains and root tubers, a food product that is similar in size and shape to rice and with similar cooking properties, to minimize difficulties in changeover.

AACC President C. L. Brooke visited the section on November 18, greeting members and discussing Association news and affairs. He addressed the group on the subject of "The past, present, and future of the cereal chemist."

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Niagara Frontier Section members met November 10 at the Erie County Technical Institute, Buffalo, beginning with dinner in the Institute's dining room. J. F. Mahoney, of Merck & Co., Inc., gave a thorough and interesting treatment of the subject, "Developing new drugs for feed use." Dr. Mahoney is manager of Merck & Co.'s technical service division.

The Christmas party on the evening of December 6, at the Thruway Lanes in suburban Buffalo, will combine bowling, beer, and a buffet dinner. Bill Davis and John Adourian have planned a fun-packed event, with prizes to be competed for.

On February 9, AACC National President Clinton L. Brooke will speak to us. A joint meeting is planned for March 9 with the Western New York Section of the Institute of Food Technologists, in the form of a plant tour, the location not yet decided upon but in the greater Buffalo area.

A new national member is Franklin P. Wagner of Feedstuffs Laboratories, Buffalo.

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Chesapeake Section's October meeting was held at the Oriole Towers, Baltimore. Frank A. Busse, director of personnel, Quality Bakers of America Cooperative, Inc., talked about what he called "The personnel tripod." He discussed personnel, from recruitment through training and the final evaluation of the individual, on the basis of three steps: selection, training, and matriculation. An informal discussion period followed.

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Pacific Northwest Section's four members (Martin Wise, Jim White, Harvie Barnard, and Lynn Speaker) who attended the Sanitation Workshop in San Francisco in September felt that the school was of great value and was comprehensively and professionally presented. The Chairman, B. L. Speaker, is putting out an inquiry among members as to whether such a session might be held in a centrally located Pacific Northwest city, at some convenient time not too far in the future, so that more members could get the benefit of the valuable training.

Kenneth Twigg, Chas. Pfizer & Co., Beaverton, Ore., is welcomed as a new member.

Northwest Section met on Sept. 26 at Jax Cafe, Minneapolis. John B. Woerfel of Armour & Co., Chicago, described physical and chemical measurements for shortenings and explained their significance in relation to shortening uses.

At the October 31 meeting Maurice P. Kerr of the U. S. Food and Drug Administration discussed the activities of the FDA in removing quack devices, quack remedies, and quacks themselves from circulation. He had on hand several such devices as exhibits.

G. W. McElroth, Professor of Industrial Engineering, University of Minnesota, spoke to the group on November 21.

A new section member is Wendell Buckley of Russell-Miller Milling Co., Minneapolis.

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Northern California Section members enjoyed a two-hour plant tour of the C&H Sugar Company at Crockett, Calif., on October 22, with cocktails and dinner in the Guest House afterward, thanks to the company's hospitality. After dinner, technical questions were answered for the group by Prescott Lloyd, who also arranged the tour, and several assistants.

The November 13 meeting was another plant tour, this time the Lucky Lager Brewing Co., San Francisco, arranged by Harold Rosoff of Lucky Lager.

The section welcomes as a new member R. M. Arnell of General Mills, Inc., Stockton, who is a National member.

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Speakers at the annual Tri-Section meeting, AACC, October 10 and 11. L to R: Raymond Vickery, head, Grain and Feed Division, Foreign Agricultural Service, USDA; Glenn H. Beck, Director, Kansas Agricultural Experiment Station; Clinton L. Brooke, Merck & Co., Inc., Rahway, N.J., and AACC President.

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Toronto and Niagara Frontier Sections met jointly on October 25, with the Association of Operative Millers as third participant, in the 8th annual Trans-Border Meeting, held at the Park Hotel, Niagara Falls, Ontario. The morning session was a combined one and afternoon sessions, AOM and AACC, were separate. Morning speaker G. M. MacLachlan of Maple Leaf-Purity Ltd., Toronto, covered the topic, "Some recent trends in collective bargaining," in a very thorough and interesting manner. Immediately following, George H. Beaton, professor of nutrition, University of Toronto, in discussing "Current problems in nutrition" stressed the subjects of 1) cholesterol via fats in the human diet vs. heart disease and 2) actual need for protein supplements in average Canadian and American diets.

AACC speakers on the afternoon program were H. A. Olendorf, Spencer-Kellogg & Son, Inc., on "Development and marketing of soy flour"; S. Skelskie, Loblaws, Inc., "Quality control in the food industry"; W. J. Jessup, Appleford Paper Products, "The properties of paper as a packaging material in the food industry"; and D. Orloff, Cornell Aeronautics Laboratories, "Computers and research." All handled their respective topics extremely well.

A fine evening banquet, floor show, and dance period, "enriched" with hospitality supplied jointly by various allied trade firms, rounded out an eminently successful day. There were close to 100 registrations for the business sessions and some 155 persons attended the banquet.

The Montrealers, via A. J. C. Willis, extended a hearty welcome to the group to have a similar meeting in their city next fall, and the initial group reaction to the warm invitation was very favorable.

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Midwest Section met Monday evening, November 3, at the Builders Club, Chicago, with 74 members and guests present. The speaker for the evening, AACC President-Elect D. B. Pratt, Jr., talked briefly about tentative plans for the 1959 annual meeting, and then gave his formal talk on "The physical and baking properties of air-classified flours." A stimulating discussion followed.

Stanley McHugh will be chairman of a special committee in charge of the Sanitation Workshop, to be held in Chicago next spring at the American Institute of Baking. Other committee chairmen just announced are: Program, E. I. Feigon; membership, Ben Grogg; house, Hal Rich; publicity, Helen Hiland; auditing, Rodger Hopper; nominating, Jan Micka; sergeant-at-arms, C. S. McWilliams.

Plans under way for the Christmas meeting include Christmas carols with an accordion player as accompanist. Mel Mickevic will be the speaker, covering his recent travels through Africa.

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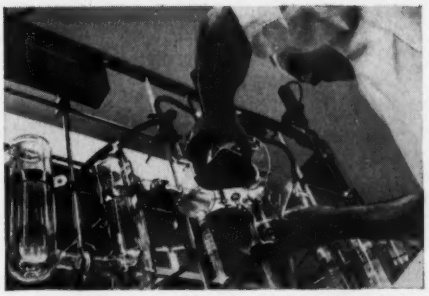
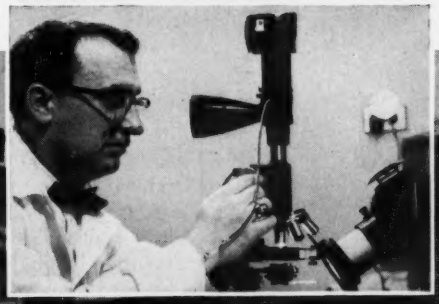
New York Section met Monday, November 10, at the Fifth Avenue Brass Rail, to hear Karl F. Mattil speak on "Fats and oils and their relation to the cereal industry." Dr. Mattil is with Swift & Co., Chicago, in charge of research on edible fats and oils, and has been close to the many improvements and new developments in the shortening industry. He emphasized "design of shortening," covering the factors and decisions that have influenced the choice of raw materials leading up to present-day shortenings. A very lucid explanation was given of factors determining the choice of base oil or fat in shortening production, and of the function of the plasticizer in developing a good plastic range. The need for the proper types and amounts of emulsifiers to give the desired functional properties was emphasized. With the use of slides, Dr. Mattil described the crystalline formations encountered in producing "rearranged" or crystal-modified lard and discussed effects of crystalline types upon functional and physical characteristics of the shortening. The session was followed by a lively discussion period.

At the next meeting, on December 9, Clinton L. Brooke, National President, will speak on "The past, present, and future of the cereal chemist."





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• • • People

C. H. Bailey, professor and dean emeritus, University of Minnesota, received honorary membership in the German Association of Cereal Research, presented at their meeting in Detmold, Germany, on October 8. The honor was conferred, writes **P. F. Pelshenke** from Germany, not only for Dean Bailey's achievements in cereal chemistry research but also in appreciation of the warmth of his personality as expressed in his relations with the European scientists.

Robert M. Hamilton named manager of protein sales for oilseeds division of General Mills.

Alan W. Huebner and **John L. Kipp** join products research department, Food Division, of Procter and Gamble.

Fred M. Ketch, General Foods research laboratory at Tarrytown, N. Y., visited Pendleton, Oregon, in September to attend his son Paul's wedding.

Robert A. Larsen, manager of Central Research, The Pillsbury Co., appointed to the Committee on Cereal and Baked Products, Advisory Board on Quartermaster Research and Development, a part of the National Academy of Sciences – National Research Council.

E. Mitchell Learmonth, director of British Soya Products Ltd., has changed his residence to Prouds, Thaxted, Essex, with the company's transfer of their offices and laboratories from London to The Grange, Puckeridge, Hertfordshire.

Edmund L. MacDonald, Jr., named salesman for Vitamin Division of Hoffmann-La Roche Inc., from medical service representative for Roche Laboratories since 1954. He takes the place of **William J. Smith** who retired earlier this year; territory, Long Island, Westchester, New England.

John E. McKeen, president of Chas. Pfizer & Co., awarded the Golden Cross with laurel by the Greek Red Cross; said to be the organization's highest honor, conferred in this case for the help McKeen and Pfizer have given and for the work they have "done to protect humanity from various diseases."

Ludvig Reimers and Mrs. Reimers made a vacation trip to Alaska this year, visiting Tacoma en route. The Reimers' now live in Berkeley.

Otho Skaer promoted to manager of products control for Centennial Mills, Inc., at the new laboratory in the general office building being completed in Portland, Oregon. Mr. Skaer was plant superintendent at the Spokane mill.

Edgar C. Somers, head reclaim man at Kellogg Co., Battle Creek, Mich., has purchased a home at Ridge Manor, Florida, to be the future retirement home of himself and Mrs. Somers.

William V. VanScoyk appointed director of analytical laboratory, Merchants' Exchange of St. Louis; succeeds **James M. Lugenbeel** who retires after heading the lab since 1929. **Roy F. Royer** named assistant director.

Martin Wise is heading up new research program of Centennial Mills, Inc., Portland, Oregon, from company's mill in Spokane.

P. E. (Bert) Minton, Chicago, died of a heart attack on October 20. Mr. Minton received his training at Purdue University and was working out of Indianapolis, Indiana, for Wallace & Tiernan Co. at the time he joined the AACC in 1925. Later he was with the Southern Cotton Oil Co. and still later the American Molasses Co., where he was employed at the time of his death.

Mr. Minton was one of the organizers of the Midwest Section, with headquarters in Chicago; he was temporary chairman in 1930 and the first chairman. He was active in many technical and administrative committees in the AACC.

Kenneth W. Neatby, 58, director of Science Service, Canada Department of Agriculture, died October 28 in Montreal.

Dr. Neatby was born in Sutton, Surrey, England. He graduated from the University of Saskatchewan in 1926 with MSA degree in genetics and plant breeding, and received the PhD degree in genetics and plant pathology from the University of Minnesota in 1931. He was an AACC member in the 1930's and 1940's, attending a number of annual meetings during those years.

He was cereal specialist at the Rust Research Laboratory, Winnipeg, from 1926 to 1932; head of Department of Field Crops, University of Alberta, 1935–1940; then director of Line Elevators Farm Service at Winnipeg, until he became director of Science Service.

The list of Dr. Neatby's degrees, honorary degrees, affiliations in scientific societies, and accomplishments is a long and distinguished one. He played an important role in the development of Renown wheat, and shared in demonstrating new knowledge regarding rust resistance in wheat.

• • • Patter

Food additives law. A recent issue of "What's New in Food and Drug Research" devotes much of its 4-page area to the Food Additives Amendment of 1958, reproducing its essential language, and hailing it as by far the most significant piece of legislation in the past 20 years affecting the sciences and industries responsible for our food supply. The Amendment merits careful consideration by scientists, production supervisors, and executives not only in the food industries but in the chemical, packaging, warehousing, and transportation industries.

The regulations under the Act are being drafted by the Food and Drug Administration. A conference under the joint sponsorship of FDA and the Food Law Institute, held in Washington on November 24 and 25, was focused on scientific, industrial, and regulatory aspects of the new legislation.

the President's Corner

news of the association

ANNUAL MEETING OF AGRICULTURAL RESEARCH INSTITUTE

The AACC Board of Directors, at its meeting on April 7, 1958, voted to apply for Class B membership in the Agricultural Research Institute, affiliated with the National Academy of Sciences-National Research Council. The application was accepted and a technical representative and alternate to ARI were appointed.

In 1944 the National Research Council of the National Academy of Sciences established the Agricultural Board, the primary function of which is to organize committees of scientists in various fields of specialization to deal with broad problems that are of interest to both agriculture and industry. The Board provides scientific leadership to promote, evaluate, and translate to useful ends research by industry, Government, and educational institutions that is of importance to agriculture.

The Agricultural Research Institute was established in 1951 to organize the scientific talents of industry, public agencies, scientific societies, and private institutions in support of the Agricultural Board and to provide a forum for unrestricted discussion of agricultural scientific problems. The present membership of ARI consists of about 70 Class A members representing industry and about 98 Class B members representing scientific societies and State and Federal agencies.

The seventh annual meeting of the Agricultural Research Institute was held in Washington on October 13 and 14. Total registration was about 150. Featured on the program were panel discussions on problems relating to agriculture in the fertilizer industry, on public relations in agriculture and agricultural sciences, and on the mobilization of research on soil and water conservation. Dr. B. T. Shaw, Administrator of Agricultural Research Service, gave an interesting report on the new "Pioneering Laboratories" of the U.S. Department of Agriculture.

Of particular interest to AACC members is the recently published book entitled "Composition of Cereal Grains and Forages," prepared by Donald F. Miller under the auspices of the Committee on Feed Composition of the Agricultural Board. The book consists of 653 pages, mostly of data in tabular form, and is believed to be the most comprehensive available compilation of data on the subject.

The grain-processing industries are not well represented in the membership of ARI, and it would seem that a better representation might well lead to a strengthening of research activities in the field of cereal science, which would be of benefit to these industries. Complete information on the objectives, activities, and membership requirements of ARI can be obtained by writing to Dr. LeRoy Voris, Executive Secretary, Agricultural Research Institute, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D. C.

Respectfully submitted,

LAWRENCE ZELENY
AACC Technical Representative to A.R.I.

OVERSEAS REPORTS

• • • Canada

Dr. Norman Irvine, as Acting Director of the Grain Research Laboratory of the Board of Grain Commissioners for Canada, has called my attention to the inexcusable looseness of terminology used in the November *Overseas Report* on Canada (see *Letters to the Editor*, p. 262, in referring to the Laboratories (p. 253, November issue) as the "Wheat Board Laboratories."

To set the record straight, the only correct designation for the "Grain Research Laboratories of the Board of Grain Commissioners for Canada" is exactly that. The Canadian Wheat Board maintains no laboratory facilities but confers and consults with the Board of Grain Commissioners and its laboratories in relation to the sale of cereal grains.

I hope that Dr. Anderson, Dr. Irvine, and their associates will accept my sincere apologies.

L. R. PATTON

• • • England

A Symposium on Texture in Foods was held by the Food Group of the Society of Chemical Industry in London, October 13–14, 1958. Some fifteen papers were presented and discussed.

Appropriately, the first paper (by R. C. Oldfield, Professor of Psychology and Director of the Institute of Experimental Psychology, Oxford University) summarized the anatomical and physiological background to the subject of taste perception in foods. Other papers dealt with texture in boiled sweets (hard candies) and chocolate; in emulsions varying from milk to butter and baking creams; in foams produced with whipping agents, usually proteins and sugars; in gels, especially pectin gels; and in the main general classes of foods—meat, fish, eggs, and vegetables.

One paper was directly concerned with cereal science.

J. B. M. Coppock (Director of Research, Spillers, Ltd.), reading a paper as co-author with S. J. Cornford (British Baking Industries' Research Association, Chorleywood), pointed out the general importance of consistency in texture in bread and flour confectionery, though this might depend on particular circumstances. Some popular types of crusty French bread have markedly irregular crumb. In general, however, irregularity of the cellular structure of crumb is associated with faulty manufacture. In cakes, as well as bread, a high value for specific volume and a low value for average size of crumb cells together connote thinness of the cell wall, and are associated with a satisfying visual and tactile impression. In practice, tactile properties are more easily measured than are eating qualities; the two have, however, been shown to be associated. Dr. Coppock suggested tentatively that the assessment of eating qualities of bread or confectionery by means of subjective (organoleptic) tests is best arranged as a series of comparisons of pairs of samples, one member of each pair being a control. This arrangement is desirable because it is often necessary to assess relatively small differences between control and "test" samples, and the variability between control samples may be only slightly less than the difference between test and control samples. For any given number of samples, the minimum number of comparisons, which must be made to establish definite differences between respective pairs of samples, may be read from graphs.

The effect of elongating and orienting the cells of bread crumb on light reflectance and apparent color in the cut slice was explained with reference to three accepted ways of forming doughs of the "super-tex" type. The relevance of the matter rested on the fact that, in practice, visual effects cannot be dissociated from assessment of palatability.

For specific volume measurements on bread the authors use the method of displacement, with pearled barley as the medium. Calibration readings are made on wax-coated loaves immersed in water. This method may be used on cakes which are sufficiently firm to resist crushing. With soft cakes, prints of cut sections may alternatively be taken and measured, and the specific volume deduced by means of the formulas:

$V = A^2/Z$ (for square cake tins) or $V = (yA^2)/(xZ)$ (for rectangular tins), where A denotes area, y length, x breadth, and Z height at center of the section.

Crumb softness is measured in terms of weight in grams required to compress, to half its initial thickness in 1 minute, a disk of prescribed dimensions cut from the crumb. In "pup" loaves, disks should be smaller in diameter because of crust proximity, and the change in ordinates should be borne in mind in making comparisons with commercial loaves. Use of the method in studies of staling (the figure for a 5-day-old cake was over twice that after only 1 day's staling) and of the effect of fats was described. The marked individuality of flours in studies of the effect of fats in bread and cakes was emphasized.

Crumb tenderness is measured by recording the weight required to tear, in a lengthwise pull, a slab of crumb of predetermined dimensions. As an example of the indications of this method, the value obtained on a cake was nearly halved following the incorporation of 4% of cocoa solids, and the crumb became too fragile.

Stickiness of crumb is evaluated, with the "tackmeter," by measuring the force required to detach a solid disk after it has been partly embedded in the crumb by pressure. Curiously, no relation had been found between alpha-amylase content in flour and the tackmeter reading on the bread crumb.

In conclusion, Dr. Coppock emphasized that in scoring bread the subjective experience of the judges alone serves as a link between series of tests performed on different occasions.

In discussion, an interesting suggestion was made: that sound might have some connection with the sensory appreciation of baked goods. Individual audible sounds, usually of relatively low pitch, are associated with hardness and crunchiness, whereas, by contrast, one of the objections to raw fish is that it squeaks in the mouth when eaten!

It is understood that the present intention is that the papers given at the symposium should be printed in a special publication of the Society. This idea may, however, be revised if there is delay in the preparation of individual papers.

J. B. M. Coppock
C. R. Jones

AUTHOR AND SUBJECT INDEX

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